

Responsiveness Summary
G.E./Moreau Superfund Site
ESD for Technical Impracticability Waiver

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Background

On February 26, 1994, the U.S. Environmental Protection Agency ("EPA") announced a 30-day public comment period on a draft Explanation of Significant Differences ("ESD") and related documents for a waiver of ground water cleanup standards, or Applicable or Relevant and Appropriate Requirements ("ARARs") at the G.E./Moreau Superfund Site (the "Site"). As explained in the draft ESD, the waiver is based on EPA's determination that it is technically impracticable, from an engineering perspective, to restore contaminated ground water at the Site to established cleanup standards within a reasonable time period. This technical impracticability ("TI") waiver is pursuant to §121(d)(4) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended ("CERCLA"), commonly known as Superfund.

In the February 26, 1994 public notice, EPA also announced the merger of the public comment period on the draft ESD with a separate, ongoing public comment period on documents related to EPA's reevaluation of the selected remedy for aquifer restoration, which EPA had initiated in November 1990. In addition, the February 26, 1994 public notice announced a March 1, 1994 public meeting that EPA held to present information in the draft ESD and to receive oral comment.

At the request of the Town of Moreau (the "Town"), EPA extended the public comment period for an additional 30 days, until April 27, 1994. Notice of this extension was published on April 7, 1994. At their request, EPA granted a two-day extension to both the Town and General Electric Company ("GE") until Friday, April 29, 1994. On April 29, 1994, GE experienced computer problems finalizing its comments. GE requested and was granted an additional extension until Monday, May 1, 1994.

In other related matters, on February 25, 1994, EPA published two separate notices regarding the Site. One notice announced a final ESD, dated February 22, 1994, for enhancement of the containment system at the Site. The other notice announced EPA's completion of a Five-Year Review Report for the Site, dated February 17, 1994. The final ESD on the containment system enhancement and the Five-Year Review Report were made available to the public but were not part of the public comment period.

The following summarizes the public comments received on the draft ESD for the TI waiver, as well as EPA's response to these comments.

Empirical Studies of Aquifer Restoration

Comment: [GE, p. 16-19] Recent studies by EPA, the Oak Ridge National Laboratory ("ORNL"), the Office of Technology Assessment, the New York State Department of Environmental Conservation ("NYSDEC"), and others recognize that pump-and-treat technologies are not effective in restoring contaminated aquifers to established clean-up standards within reasonable time frames. Key factors identified in these studies that limit ground water restoration are aquifer heterogeneity, contaminant sorption, and stagnation zones.

EPA Response: EPA added much of this information to the Administrative Record for the Site in November 1990, when it first announced new information regarding restoration of the Moreau aquifer at the Site and the possible need to waive ground water cleanup standards. These studies show that factors limiting ground water restoration are found in many sites across the country and are not unique to the G.E./Moreau Site (see, March 1, 1994 Public Meeting Transcript, p. 14, lines 12-16).

Comment: [GE, p. 20-21] The recent studies identified above also indicate that the key factors limiting pump-and-treat technologies also limit the effectiveness of other available remedial technologies in restoring ground water. A separate empirical study by the ORNL concluded that soil vapor extraction (SVE) suffers many of the same limitations as pump-and-treat and cannot be relied upon to eliminate contamination in the soil column.

EPA Response: As part of the TI evaluation, EPA considered air sparging, which is essentially SVE technology applied below the water table. Air sparging was eliminated due to the difficulty in distributing air flow throughout the heterogeneous Moreau aquifer (see, Attachment to Draft ESD, p. 5).

Site Conceptual Model

Comment 1: [Town, p. 17 and Casson, p. 7] The Site conceptual model mischaracterizes the heterogeneity of the Moreau aquifer. EPA implies that the Moreau aquifer is anomalously heterogeneous when it states in the draft ESD, "the primary hydrogeological constraint is the high degree of variability in hydraulic conductivity across the Moreau aquifer."

Comment 2: [GE, p. 24-37] As reported in the Remedial Investigation ("RI"), the Moreau aquifer at the Site is stratified and both laterally and vertically heterogeneous. Hydraulic conductivity testing during the RI also showed heterogeneity within the Moreau aquifer: the lower portion of the aquifer has a lower hydraulic conductivity than the upper portion.

EPA Response: Hydraulic conductivity is a measurement of the ease with which water passes through a hydrogeologic unit, and is generally high for sand and gravel and low for silt and clay. Lateral and vertical heterogeneity refer to differences in hydraulic conductivity depending upon direction within a hydrogeologic unit, which in unconsolidated units often reflects the variability in grain size within aquifer layers. The heterogeneity and the hydraulic conductivities used in the Site conceptual model are based on those reported in the 1984 RI Report (see, EPA's report entitled "Comparison of Ground Water Restoration Methods for the G.E./Moreau Superfund Site: An Application of Nonideal Contaminant Transport Modeling (the "July 1993 Final Report"), p. 5, and Attachment to Draft ESD, pp. 1-2). Specifically, the upper 75% of the Moreau aquifer material at the Site ranges from coarse sand to fine sand with occasional silt and clay lenses, and the lower 25% consists of interbedded fine sand, silt, and clay seams. As expected from these types of materials, the hydraulic conductivity measurements taken during the RI are lower in the lower 25% of the Moreau aquifer and higher in the upper 75%. EPA disagrees with the assertion that the Site conceptual model implies that the Moreau aquifer is anomalously heterogeneous. The Site conceptual model fairly characterizes the Site and in no way compares the Site to others.

Brusseau Model as Generic vs. Site-specific

Comment: [Town, p. 16; Casson, p. 7] The Brusseau model is generic rather than site-specific.

EPA Response: The Brusseau model is a generic model that became site-specific when Site-specific input parameters and conditions were specified in the modeling runs. As stated in the 1993 U.S. Geological Survey Technical Memorandum (p. 76):

"When a numerical algorithm is implemented in a computer code to solve one or more partial differential equations, the resulting computer code can be considered a generic model. When the parameters (such as hydraulic conductivity and storativity), boundary conditions, and grid dimensions are specified to represent a particular geographical area, the resulting computer program is a *site-specific* model" (emphasis retained).

Proprietary Nature of Brusseau Model

Comment: [GE, p. 49-50] The fact that the code for the Brusseau Model is proprietary and confidential and thus not placed into the Administrative Record is of no moment. EPA made the model code available to anyone, including New York State and the Town, who could obtain the code if they agreed to a stipulation of confidentiality. In addition, relevant case law indicates that

agencies may rely upon data available in agency files when making decisions as long as the agency has informed the parties of the data that has been utilized. Here, EPA has not only informed the parties of the data that it was using, but also made the data available under a stipulation of confidentiality.

EPA Response: Typical of most research models, the Brusseau model is a proprietary model accessible only through its author, Dr. Brusseau. As indicated in the July 1993 Final Report (p. 8), EPA took several measures to ensure that use of this proprietary model enhanced the objectives of the study and allowed EPA to fulfill its role in the regulatory process:

1. EPA investigated the possibility of using a model in the public domain that similarly accounts for nonideal contaminant transport. To this end, EPA contacted the International Ground Water Modeling Center ("IGWMC"), now located at the Colorado School of Mines in Boulder, Colorado. The IGWMC responded that no such model was available in its database of more than 100 ground water models. Moreover, EPA was advised that any similar model would also likely be proprietary (see, February 22, 1991 letter from EPA to NYSDEC).
2. EPA actively sought the participation of technical representatives of New York State, the Town of Moreau, and GE in its Site-specific modeling effort. In particular, EPA made Dr. Brusseau available to these technical representatives in numerous teleconferences and meetings. This collaborative approach improved the modeling effort, and contributions from these parties were noted in EPA's reports.
3. EPA included, in the Administrative Record File for the Site located at three (3) local public repositories, papers from the scientific literature that describe the Brusseau model and its capabilities. EPA notified the public of, and solicited public comment upon, these papers from November 1990 through April 1994.
4. EPA placed the Site-specific modeling results into the Administrative Record File after each modeling run. EPA's modeling reports describe the application of the Brusseau model, its capabilities, and the Site-specific modeling results in non-confidential and, as much as possible, lay terminology. EPA solicited public comment on these reports and on the modeling methodologies and results.
5. EPA sought to enable interested parties' review of the entire model, including the proprietary components. Dr. Brusseau agreed, in principle, to release the computer model pursuant to a Stipulation and Protective Order, and EPA provided NYS, the Town, GE, and Dr. Brusseau with a draft Stipulation and Protective Order (November 30, 1992 letter from EPA to NYS and Town; November 30, 1992 letter from EPA to Dr. Brusseau; and

December 1, 1992 letter from EPA to counsel for GE). None of these entities requested that EPA facilitate finalization of such an Order.

Model Verification

Comment: [Town, p. 16; Casson, p. 7] The Brusseau model was not verified, which is a basic quality control procedure. Therefore, the modeling results do not reasonably represent processes occurring or [believed] to occur in the aquifer, and predictions are not based on and do not represent actual conditions or behavior of the aquifer.

EPA Response: Verification is performed by comparing the results produced by a model with the results obtained from analytical solutions, for a simple case. As stated in the July 1993 Final Report (p. 9), the Brusseau model was verified and the results were presented in the peer-reviewed scientific literature in Brusseau (1989). This verification demonstrated, prior to and independent of EPA's Site-specific use of the Brusseau model, that the Brusseau model computer code accurately solves the governing equations that constitute the mathematical model.

Selection of the Contaminant Modeled

Comment: [Charlotte Lewis] What chemicals were addressed in the modeling?

EPA Response: EPA modeled trichloroethylene ("TCE") because it is the primary contaminant (i.e., highest concentration) in ground water at the Site and because the remedial alternatives that reduce the level of TCE to acceptable concentrations would also reduce the other volatile organic compounds ("VOCs") present in the ground water to acceptable concentrations (see, EPA's July 1993 Final Report, p. 12).

Site-specific vs. Non-site Specific Input Parameters

Comment 1: [Town, p. 16; Casson, p. 7] The input parameter values are not site-specific, as requested by NYSDEC in its December 12, 1990 letter to EPA. Since the input is not site-specific, the results of model runs cannot be used to predict real aquifer restoration time frames.

Comment 2: [Charlotte Lewis] Data from which aquifers were used to model the Moreau aquifer? If site-specific data were not used, how can the modeling results be accepted?

EPA Response: In its July 1993 Final Report, EPA clearly identified which input parameter values were site-specific and which were non-site specific. NYSDEC's 1990 letter requesting certain site-specific data was followed by many meetings and

teleconferences among the technical representatives of EPA, NYSDEC, GE, and the Town; correspondence documenting these technical discussions is in the Administrative Record File for the Site. As a result of the technical discussions, EPA performed additional rounds of modeling, including a sensitivity analysis to determine which input parameters have the greatest effect on the model output. Based on the 1991 Sensitivity Analysis Report, EPA and NYS agreed to estimate certain input parameters based on Site information and comparison with other aquifers rather than perform additional field work (see, August 2, 1991 letter from EPA to NYSDEC). NYSDEC and EPA agreed on the selection of all input parameter values for the final modeling run (see, October 20, 1992 letter from NYSDEC to EPA).

Where site-specific data were not available for non-sensitive input parameters (i.e., input parameters determined through the sensitivity analysis to have a small effect on the output), EPA used data from similar sandy aquifers, including the Borden aquifer, which is a well-studied aquifer in Canada that serves as a field site for the University of Waterloo Centre for Groundwater Research. Where site-specific data were not available for sensitive input parameters (i.e., parameters that greatly affect the output), EPA used data from similar aquifers, notably the Borden aquifer, and modeled reasonable upper and lower limits for the Moreau aquifer using bracketing techniques (see, discussions herein on bracketing). This level of certainty in the modeling results was acceptable to EPA and NYSDEC for the purpose of comparing remedial alternatives at the Site (see, discussion herein on absolute vs. comparative use of modeling results).

"Bracketing" of Input Parameters

Comment: [Town, p. 17 and Casson p. 8] Plugging in high and low values for input parameters does not result in high and low restoration time frames, or in a range of restoration time frames corresponding to the range of input values. This is because the governing equations of the model are complex and the input parameters are interdependent. EPA has not "bracketed reality."

EPA Response: The use of high and low input parameter values to obtain a corresponding range of model output (in this case restoration time frames and number of pore volumes) is routine and is not invalidated by the complexity or interdependency of the governing equations. In fact, such use of high and low input values is how the sensitivity of output to input parameters is determined in a sensitivity analysis. As indicated in its July 1993 Final Report (p. 18-20), EPA estimated high and low values for the retardation factor (and consequently, the first-order reverse rate constant) and ground water velocity for the pulsed pumping scenario at the Site that represent reasonable upper and lower limits for these parameters at the Site. The values for

these parameters at the Site are expected to be somewhere within the range modeled in the 1993 final modeling run, based on Site information and on data from other aquifers that are similar to the Moreau aquifer. Using this "bracketing" technique, EPA obtained a range of predicted time frames and pore volumes for the remedial scenarios that corresponds to the range of conditions possible at the Site.

Pulsed Pumping Velocity Input Values

Comment 1: [Town, p. 19; Casson, p.8] The pumping velocities were arbitrarily reduced from the 1992 to the 1993 modeling run.

Comment 2: [GE, pp. 65, 67, 69] The change in velocity from the 1992 to 1993 modeling run was made because the earlier flow rates could not be achieved in the Moreau aquifer except within a few feet of a pumping well. The velocity of ground water flow used by Dr. Brusseau for the pumping scenario in the final 1993 modeling may still be somewhat higher than could be achieved throughout the aquifer, but is certainly more realistic than the velocities used in the previous modeling runs.

EPA Response: The pulsed pumping velocity was reduced from the 1992 to the 1993 modeling runs based on discussions among technical representatives of EPA, NYSDEC, GE, and the Town with respect to the sustainable yield of the Moreau aquifer, not arbitrarily by EPA. At a July 30, 1992 meeting, EPA and NYSDEC agreed, based on Site information, that the pulsed pumping velocity assumed in the 1992 modeling run (100 times faster than the natural ground water velocity) was too high to be sustained over the entire thickness of the aquifer in the plume area (see, September 8, 1992 letter from EPA to NYSDEC). Subsequently, at an October 5, 1992 meeting, technical representatives of EPA, NYSDEC, GE and the Town discussed this matter, and EPA agreed to perform a final round of modeling with reduced ground water velocities for the pulsed pumping scenario, ranging from one-half an order of magnitude (5 times) to one order of magnitude (10 times) greater than the ground water velocity under natural conditions (see, NYSDEC's letter to EPA dated October 20, 1992 and EPA's letter to NYSDEC, GE, and the Town dated December 14, 1992). This technical basis for the reduction in ground water velocity was also reiterated in EPA's July 1993 Final Report (pp. 17-18).

Model Grid (Simulation or Unit Cell) and Linear Scaling

Comment 1: [Town, p. 18 and Casson, p. 9] The modeled unit cell is 50 meters in length, equal to 1/29 the length of the plume in the direction of ground water flow, and 6 meters thick. These dimensions distort the geometry of the plume. In addition, the predictions of ground water restoration time frames obtained from

modeling of the unit cell are erroneously scaled up to the size of the Moreau plume in a linear fashion, which assumes only one pumping well when 29 wells are needed to remediate the length of the Moreau plume. As a result, ground water restoration at the Site can be achieved in 1/29 the time frame stated in the July 1993 modeling report, or within 6.5 to 14 years.

Comment 2: [GE, p. 55] To simplify the analysis, Dr. Brusseau modeled a scaled-down "unit cell" representing a vertical slice of a portion of the Moreau aquifer. The unit cell is 50 meters long in the direction of ground water flow and 6 meters in the vertical dimension representing the thickness of the aquifer. Twenty-nine (29) unit cells are required to represent the full length of the contaminant plume. The vertical thickness of the unit cell is not important; only the relative proportions of the layers are believed to influence the model results. A uniform grid of 1000 rectangular elements was used in the modeling, with 50 1-meter long elements along the length of the unit cell and 20 0.3-meter high elements across the height of the unit cell.

EPA Response: The dimensions of the simulation cell provided by the two commenters are correct. The relative thicknesses of the layers in the unit cell (4.5 m and 1.5 m) were properly selected to be proportional to the layers in the Moreau aquifer (upper 75% is glaciodeltaic and lower 25% is glaciolacustrine). Moreover, because the dimensions of the simulation cell were the same throughout the modeling, the predicted results for each remedial scenario can be compared directly to one another (see, discussion herein on absolute vs. comparative use of modeling results).

Linear scaling is appropriate for the Brusseau modeling results because the Brusseau model assumes one well (see, Brusseau 1992, p. 6), which is located at the downgradient end of the unit cell. The concentration of TCE at the well is compared to the target concentration to determine when the cleanup standard has been attained. The Brusseau model does not simulate pumping from this well or evaluate multiple well pumping scenarios, which would create complex flow paths (i.e., ground water velocities that decrease with distance away from the pumping wells and interference effects or stagnation zones depending on well spacing). Instead, the model contains an idealized simplifying assumption that the ground water flow rate is uniform within each of the two layers at the velocities specified by the input parameters.

In response to questions regarding linear scaling, Dr. Brusseau stated in a March 6, 1991 teleconference with technical representatives of EPA, NYSDEC, GE, and the Town, "...scaling would not be linear where the remediation scenario modeled involves complex flow paths, such as from a multiple well pumping system" (see, EPA's March 25, 1991 letter summarizing the March 6, 1991 teleconference). The pulsed pumping scenario envisioned

by the first commenter is a multiple well system (29 pumping wells), which would create complex flow paths; therefore, linear scaling (i.e., dividing the Brusseau modeling results by 29) is not appropriate. Because EPA did not model complex flow paths, linear scaling of its modeling results is appropriate.

Model Calibration

Comment: [Town, p. 16 et seq. and Casson, p. 5] The Brusseau model application was not calibrated to the Moreau aquifer, which is standard operating procedure within the hydrogeologic community (ref., U.S. Geological Survey ("USGS") Technical Memorandum No. 76.20). Therefore, the results do not reasonably represent processes occurring within the aquifer and the predictions are not based on actual conditions or behavior of the aquifer.

EPA Response: Calibrating (history matching) is a demonstration that the model can predict field-measured values. EPA presented its technical basis for not calibrating (history matching) in its July 1993 Final Report (p. 26):

"[V]alidation of the modeling by history matching is not possible. History matching, a demonstration of the model's ability to reproduce field-measured values, provides confidence that the modeling accurately predicts what would happen in the field. However, a general rule of thumb is that history matching provides confidence for predictions two (2) to three (3) times longer than the time period over which the field data were collected (M. Beljin, pers. comm., 1993).

In this case, because the predictions are from 200 to 500 years, history matching would require 70 to 250 years of field data to determine whether the model predictions are reliable. In addition, it is impossible to collect field data for both [the natural gradient flushing and the pulsed pumping] remedial scenarios at the same time, and collecting field data for one remedial scenario would alter the initial conditions of the modeling for the other. By using the modeling results in a comparative sense, we obviate the need for history matching."

Furthermore, EPA contacted the USGS to obtain a copy of its Technical Memorandum No. 76.20, which was referenced but not submitted by the commenter. The USGS provided EPA with a copy of Technical Memorandum No. 76.20, dated 1976, and advised EPA that it had been superseded by a 1993 Technical Memorandum (No. 93.04) entitled, "Ground-water Models Cannot Be Validated" (see, June 1, 1994 memo from USGS to EPA, attached). EPA's TI evaluation is consistent with the USGS 1993 Technical Memorandum in its recognition of uncertainty in predictive ground water modeling,

its decision not to attempt calibration by history matching, and in making its TI determination based on technical evaluation of all Site information and not solely on the results of ground water modeling. Despite the fact that the Brusseau model results could not reasonably be calibrated with Site ground water restoration data and the tendency of the simplifying assumptions of the model to underpredict actual ground water restoration time frames and pore volumes, EPA believes that the model results provide the best available estimates of ground water restoration at the Site (see, discussion herein on absolute vs comparative use of modeling results).

Absolute vs. Comparative Use of Modeling Results

Comment 1: [Town, pp. 21-23] In reports concerning the restoration of the Moreau aquifer at the Site, Dr. Brusseau stated that model results are not predictions of actual restoration time frames and should be used for comparative purposes only. Nevertheless, EPA argues that the model predictions represent minimum restoration time frames and is using the model as though it predicted real time frames. The public should not be hood-winked into thinking that the complex equations used yield real predictions of restoration times.

Comment 2: [GE, p. 44, 67 et seq.] Due to the many conservative assumptions, the Brusseau model potentially underestimates the absolute time frames required to actually restore the aquifer to established standards, especially for those simulations involving use of a pump-and-treat system. The conservative factors include properties related to ground water flow (aquifer layering, ground water flow velocity, stagnation zones), properties related to contaminant migration (equilibrium sorption capacity, longitudinal dispersivity, vertical dispersivity, porosity, fraction of equilibrium sorption sites, first-order reverse rate constant, condition of initial sorption), and the criteria used to assess aquifer restoration (fully penetrating well, rebound concentrations).

EPA Response: Modeling of ground water contaminant fate and transport requires simplifying assumptions and therefore is not expected to represent actual field conditions or provide predictions of actual restoration. EPA recognized that actual restoration of contaminated ground water at the Site would differ from the results predicted by the Brusseau model because of the simplifying assumptions and conservative approach used in selecting input parameters, which were likely to underestimate the time frames and number of pore volumes required for restoration (July 1993 Final Report, p. 10-12, 26-27). EPA used the final 1993 results as follows: (July 1993 Final Report, p. 26):

"Given the methods and assumptions used in this modeling, these results are best interpreted as minimum time frames and pore volumes, to be used in a comparative analysis of ground water restoration alternatives...Comparing these results, it appears that the natural gradient flushing alternative is more efficient than pumping in removing contamination from the Site. The volume of water requiring treatment in the natural gradient flushing alternative (24-55 pore volumes) is significantly less than the pulsed pumping alternative (88-278 pore volumes). In addition, the modeling results indicate that the minimum timeframes for restoration by these alternatives are comparable (237-542 for natural gradient flushing vs. 191-404 for pulsed pumping)."

Pilot Study

Comment: [Town, p. 17] A pilot study was not conducted to calibrate or verify the model, or to enhance or refine the model.

EPA Response: Implementation of a pilot study would not result in verification of the Brusseau model or in calibration of the Brusseau modeling results for the Site. As stated in EPA's July 1993 Final Report (p. 9), the Brusseau model was verified and the results presented in the peer-reviewed scientific literature (Brusseau, 1989). Calibration of the model results is not possible (see, discussion herein on model calibration). Lastly, enhancement or refinement of the modeling using data from a pilot study was not necessary, given EPA's use of existing data and the comparative use of the modeling results (see, discussion herein on absolute vs. comparative use of the modeling results). In addition, as stated in Dr. Brusseau's April 19, 1991 report, entitled "Alternative Methods for Estimating Time Required for Aquifer Restoration," a pilot study approach is more time consuming and expensive than other methods and does not guarantee accurate projections for the entire Site.

Potential for Restoration by Pulsed Pumping

Comment: [Town, p. 31; Casson, p. 9]. The aquifer can be remediated by pulsed pumping.

EPA Response: It would be feasible to design and construct a pulsed pumping remedy at the Site. Therefore, pulsed pumping was considered as a remedial alternative in the reevaluation of the selected remedy for ground water restoration at the Site. However, the available information indicates that neither pulsed pumping nor natural gradient flushing would be able to restore the Moreau aquifer at the Site to ground water cleanup standards within a reasonable time frame; therefore, ground water restoration is not practicable at the Site.

Objectives for Alternative Remedial Strategies

Comment: [Town, p. 32, 37] Even if the aquifer cannot be restored to ARARs, EPA should develop substitute standards in place of ARARs which can be met.

EPA Response: The NCP describes EPA's expectations for sites at which ground water cannot be restored to ARARs within a reasonable time frame (40 CFR § 300.430(a)(1)(iii)(F)):

"EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. When restoration of ground water to beneficial uses is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated ground water, and evaluate further risk reduction."

In its draft ESD (pp. 6-7), EPA considered these expectations in light of the specific circumstances at the Site:

"With respect to preventing plume migration, EPA's 1987 ROD requires monitoring ground water on a semi-annual basis to detect any changes in the size or direction of the plume. To date, these data indicate no such changes in the plume. With respect to preventing exposure to the contaminated ground water, GE has provided a permanent public water supply for the approximately 100 residences determined by EPA to be affected and potentially affected by the ground water plume, as required by the 1987 ROD. Moreover, a February 24, 1993 Site Review and Update performed by the Agency for Toxic Substances and Disease Registry ("ATSDR") states that ATSDR and the New York State Department of Health believe that no significant exposure to Site contaminants is currently occurring. Although EPA believes that no further risk reduction is necessary at the Site beyond the continued operation and maintenance of the ROD remedy [which includes the enhancement to the containment system required by a separate ESD issued on February 22, 1994], it continues to recommend that the Town of Moreau establish institutional controls for restricting the withdrawal of ground water within the plume area, as stated in the 1987 ROD."

EPA may require compliance with a less stringent ARAR than the one determined to be unattainable, where appropriate. For example, an original ARAR based on a more stringent State cleanup

level may be unattainable while a less stringent ARAR for the same compound, such as the Federal Maximum Contaminant Level ("MCL"), may be attainable (see, OSWER Directive 9234.2-25 entitled, "Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration," September 1993 (the "TI Guidance"), p. 20). This situation is not applicable to the Site--the Federal and State MCLs for TCE, the primary contaminant, are both 5 ppb.

Cyanide and Heavy Metals

Comment 1: [Fuchsberg] The air, soil, and ground water at the Site should be tested for cyanide and heavy metals to ensure that all contaminants emanating from the Site have been identified prior to EPA making a final determination with regard to the waiver of ground water cleanup standards.

Comment 2: [GE, p. 7] In response to concerns of four area residents that their homes were being contaminated by certain substances, including cyanide and heavy metals, the New York State Department of Health ("NYSDOH") in 1993 and 1994 conducted an investigation, including air, water, and soil sampling, to determine if the resident in question were in fact being exposed to such substances, regardless of what the source of any such substances might be. NYSDOH reported that its investigation found nothing of any health significance.

EPA Response: The 1984-1985 RI was conducted to determine the nature and extent of contamination at the Site. Samples analyzed as part of the RI did not indicate that cyanide or heavy metals were contaminants of concern at the Site. In addition, EPA coordinated with the NYSDOH during its 1993-1994 investigation of the possible presence of cyanide and heavy metals emanating from the Site to nearby homes, including analysis of air, soil, and water samples. NYSDOH determined that cyanide and heavy metals are not present at levels of health significance. Based on the data obtained during the recent NYSDOH investigation and historical sampling results, EPA believes that cyanide and heavy metal are not among the contaminants associated with the Site. Regardless, EPA's waiver of ground water standards is limited to the VOCs detected in the ground water plume at the Site. Should future monitoring indicate the presence of additional contaminants, the waiver would not diminish EPA's authority to take action with respect to those additional contaminants.

Administrative Requirements for TI Waiver

Comment 1: [Town, p. 19] EPA did not comply with the NCP requirements for the collection of sufficient site-specific data, the development of a conceptual understanding of the site, and site characterization including treatability studies (40 CFR

\$300.430(a)(1)(ii)(C); 40 CFR \$300.430(b)(2); and 40 CFR \$300.430(d)(1), respectively).

Comment 2: [GE, p. 4, 45] EPA's issuance of the ESD and its conclusion that ARARs for ground water must be waived are in accordance with and firmly supported by CERCLA, the NCP, relevant guidance documents, and the Administrative Record for the Site. In particular, EPA's use of the Brusseau model falls squarely within the discretionary acts that EPA may perform in selection of a remedy pursuant to 40 CFR \$300.400 et seq. and is consistent with the site-specific data needs, the evaluation of alternatives, and the documentation requirements (40 CFR \$ 300.430(a)(1)(ii)(C); 40 CFR \$ 300.430(b); and 40 CFR \$ 300.430(e)(9)(iii), respectively.

EPA Response: The NCP citations above relate to the performance of the RI and Feasibility Study and EPA's Selection of the Remedy. EPA had complied with these requirements at the time of issuance of the 1987 ROD. The information gathered during the RI/FS, including the collection of Site data and development of a site conceptual model, in conjunction with the new information gathered by EPA on aquifer restoration, were sufficient for EPA to perform a TI evaluation.

Sufficiency of Information for TI Determination

Comment 1: [Town, p. 15, 24, 27-32] EPA's decision to waive ground water cleanup standards is based entirely on predicted time frames for aquifer restoration obtained from running of the Brusseau model, which is insufficient. CERCLA and the NCP show that technical impracticability is an empirical, site-specific determination involving a balancing of benefits and detriments. EPA guidance documents also show that EPA must implement a pilot study or a restoration remedy to make an empirical determination of whether ARARs can be met. Without data from a pilot study or other restoration remedy, EPA has determined presumptively that restoration of the Moreau aquifer at the Site is impracticable.

Comment 2: [GE] EPA's decision that it is technically impracticable to attain ground water cleanup standards at the Site is supported by the scientific literature and by site-specific data. [GE, p. 15, 24] Factors which limit the effectiveness of pump-and-treat and other remedial technologies are present at the Site. The aquifer at the Site is heterogeneous and contaminants at the Site are sorbed onto the aquifer materials.

EPA Response: The regulatory framework for TI waivers is described on pp. 9-10 of the TI Guidance, which was added to the Administrative Record File for the Site. Neither CERCLA, the NCP, or EPA guidance requires implementation of a pilot study for a remedy that the Agency believes will not work at a site.

Rather, for a TI waiver EPA is required to make a site-specific TI determination. In performing its TI evaluation for the G.E./Moreau Site, EPA considered site-specific hydrogeologic and contaminant-related information (see, Attachment to Draft ESD, Technical Memorandum: Summary of Supporting Information for ARAR Waiver Based on Technical Impracticability), in addition to the site-specific modeling of aquifer restoration. This evaluation led EPA to determine that it was technically impracticable to restore ground water within a reasonable time frame at the Site. EPA's determination is in accordance with CERCLA, the NCP, the TI Guidance and other relevant EPA guidance.

Completeness of the Administrative Record

Comment 1: [Town, p. 19] The record underlying the draft ESD for the waiver is incomplete and inadequate for public comment. Specifically, the record fails to include a) the disk for the model; b) documents that reflect other models, if any, that EPA considered; c) documents reflecting alternatives to use of a computer model; d) documents reflecting the grid underlying the model; e) water quality data reflecting the current condition of the ground water plume; f) documents pertaining to use of pilot studies; g) documents reflecting calibration of the model; h) documents reflecting verification of the model; i) documents reflecting the procedures and protocols for running the model; j) documents reflecting the simplifying assumptions of the model; k) computer printouts of the runs of the model; l) documents reflecting EPA's decision to reduce pumping velocities and EPA's choice of a reduced velocity value; and m) documents reflecting EPA's decision to use linear scaling.

Comment 2: [GE, p. 3, 49] Information generated during the course of EPA's reevaluation of ground water restoration alternatives and considered by EPA in reaching this decision is included in the Administrative Record. The Administrative Record provides a full, fair, and well-documented description of EPA's modeling activities at the Site and of the basis for EPA's use of various input parameters.

EPA Response: The Administrative Record File for the TI waiver is complete upon the addition of the public comments received during the public comment period, EPA's responsiveness summary (this document), EPA's final decision document with respect to the waiver, and the public notice announcing the final decision. EPA's general response for each of the items noted in Comment #1 is as follows (see also, letters from EPA to the Town dated November 30, 1992, May 13, 1993, and July 12, 1993, which are in the Administrative Record File):

a) the disk for the model: The Administrative Record File contains papers from the scientific literature describing the Brusseau model, but does not include a disk with the computer

code of the Brusseau model, which would require a DEC VAX mainframe computer and modeling expertise to be run. Moreover, in the Administrative Record File, EPA summarized the measures it took to ensure that use of the Brusseau model enhanced the objectives of the study and allowed EPA to fulfill its role in the regulatory process. Among other things, EPA prepared modeling reports that describe the application of the Brusseau model, its capabilities, and the Site-specific modeling results in lay terminology, to the extent possible (see, EPA's July 1993 Final Report, p. 8; see also, discussion herein on proprietary nature of Brusseau model).

b) documents that reflect other [computer] models, if any, that EPA considered: The Administrative Record File contains EPA's February 22, 1991 letter to NYS documenting EPA's attempt to find a publicly available model similar to the Brusseau model (see, EPA's July 1993 Final Report, p. 8, and discussion herein on proprietary nature of Brusseau model). No such model was found.

c) documents reflecting alternatives to use of a computer model: The Administrative Record File contains Dr. Brusseau's April 19, 1991 report entitled, "Alternative Methods for Estimating Time Required for Aquifer Restoration" (in Ross, 1992), which identified three (3) methods of estimating ground water restoration: hydraulic calculations of pore volume replacement, modeling, and pilot study. EPA's July 1993 Final Report, which is in the Administrative Record File, discusses the recent estimates of ground water restoration based on modeling and the previous estimates based on hydraulic calculations of pore volume replacement.

d) documents reflecting the grid (i.e., array of elements within the simulation or unit cell) underlying the model: The Administrative Record File contains the July 6, 1993 Final Report, which has a description and a graphic representation of the simulation cell and its array of elements (pp. 13-14) (see also, discussion herein on model grid (simulation or unit cell) and linear scaling).

e) water quality data reflecting the current condition of the ground water plume: The Administrative Record File contains the ground water sampling data from the Site that were used to select the initial TCE concentrations for the two layers of the unit cell. These Site data are contained in the 1984 Remedial Investigation Report and the March 30, 1988 sampling results reported to EPA (see, August 20, 1991 letter from EPA to NYS, and EPA's July 1993 Final Report, p. 20). The model results are used in a comparative fashion (see, discussion herein on absolute vs. comparative use of modeling results), so use of ground water data from the 1980s rather than current data from the early 1990s does not affect the interpretation of the modeling results.

- f) documents pertaining to use of pilot studies: The Administrative Record File contains an August 2, 1991 letter from EPA to NYS documenting the decision not to conduct a pilot study at the Site (see also, discussion herein on pilot studies).
- g) documents reflecting calibration of the model: The Administrative Record File contains EPA's July 1993 Final Report (p. 26), which provides EPA's technical rationale for not calibrating (history matching) the model results (see also, discussion herein on model calibration);
- h) documents reflecting verification of the model: The Administrative Record File contains documents that reflect verification of the Brusseau model (see, Brusseau, 1989; see also, EPA's July 1993 Final Report, p. 9; and discussion herein on model verification);
- i) documents reflecting the procedures and protocols for running the model: The Administrative Record File contains EPA's July 1993 Final Report, which contains a discussion on general ground water modeling protocols (pp. 3-4) and provides a basic step-by-step description of how the Brusseau modeling was performed (p. 13);
- j) documents reflecting the simplifying assumptions of the model: The Administrative Record File contains EPA's July 1993 Final Report, which outlines the simplifying assumptions of the Brusseau model (pp. 10-12);
- k) computer printouts of the runs of the model: The Administrative Record File contains a printout of an output file generated by the Brusseau model, which was produced at the Town's request (see, EPA's July 12, 1993 letter to the Town). Other printouts do not exist because the computer model is designed to transfer the output data to a post-processor computer program that generates graphs, such as those included in the Administrative Record File for each of the modeling runs (see, EPA's May 13, 1993 letter to the Town);
- l) documents reflecting EPA's decision to reduce pumping velocities and EPA's choice of a reduced velocity value: The Administrative Record File contains EPA's July 1993 Final Report, which documents EPA's technical rationale for reducing the pumping velocities for the pulsed pumping and its choice of reduced velocity values (see, EPA's July 1993 Final Report, pp. 17-19 and discussion herein on pulsed pumping velocity input values).
- m) documents reflecting EPA's decision to use linear scaling: The Administrative Record File contains EPA's March 25, 1991 letter, which summarizes a March 6, 1991 teleconference with Dr. Brusseau and technical representatives of EPA, NYSDEC, GE, and

the Town documenting the appropriateness of EPA's use of linear scaling (see also, discussion herein on linear scaling).

ESD vs. ROD Amendment

Comment 1: [Town of Moreau, p. 10, 12, 14] An ESD is not the proper vehicle for waiving ARARs; the waiver requires a ROD amendment.

Comment 2: [GE] An ESD is the appropriate mechanism for the waiver of ground water cleanup standards.

EPA Response: As part of the TI evaluation, EPA consulted its guidance document EPA/540/G-89/007 entitled, "Guidance on Preparing Superfund Decision Documents: The Proposed Plan, The Record of Decision, Explanation of Significant Differences, and The Record of Decision Amendment," dated July 1989. This guidance describes three (3) types of post-ROD changes: 1) a non-significant or minor change, which is documented in the file; 2) significant change to a component of the remedy, which is documented in an Explanation of Significant Differences ("ESD"); and 3) a fundamental change to the overall remedy, which requires a ROD Amendment. A post-ROD TI waiver can be documented either in an ESD or a ROD Amendment, depending on whether it is a significant change to a component of the remedy or a fundamental change to the overall remedy (TI Guidance, p. 24). EPA determined that the TI waiver for the Site should be documented in an ESD because the waiver does not fundamentally change the remedy. With the waiver, the remedial action at the Site continues to consist of the containment system (slurry wall and cap), natural gradient flushing of the contaminated ground water to its discharge at Reardon Brook, treatment of VOCs by air stripping at Reardon Brook, provision of an alternative water supply to residences affected or potentially affected by the Site, maintenance and monitoring, and review of the Site no less often than every five years. The waiver is a significant change to a component of remedy, to wit, the aquifer restoration component, in that EPA expects that the ground water standards will be met in a time frame of 200 years or more rather than within decades. Despite its determination that the change in the remedy warrants an ESD, EPA is, within its discretion, complying with all the procedural requirements of a ROD Amendment, including publishing of a public notice in a local newspaper of general circulation, public comment period, public meeting, responsiveness summary (this document), public notice of final decision, and placement of all these documents in the Administrative Record.

Judicial Framework for TI Evaluation

Comment 1: [Town, p. 8] When the ROD was published, "decades" was, according to EPA, a reasonable enough restoration time so that a waiver of ground water standards was not required. EPA did not intend to waive ARARs in the ROD... [p.11] EPA is well aware that the ROD chose a remedy for aquifer restoration which waives ARARs, and that the Administrative Record underlying the ROD offers no basis for such a waiver. The Court found that EPA had waived ARARs in the ROD. This ESD is nothing more than a post-hoc rationalization for EPA's illegal waiver of ARARs in the ROD.

Comment 2: [GE, p. 8] EPA stated in the ROD that restoration of the contaminated portion of the aquifer to ground water standards or ARARs should occur within a time period of decades; thus, EPA did not at that time seek a waiver of ARARs. Subsequently, however, in a court proceeding, the State asserted that ARARs would not in fact be achieved and thus had been effectively waived.

EPA Response: Based on the information available at the time of the issuance of the 1987 ROD, EPA believed that ground water standards would be attained in a matter of decades (see, ROD, p. 12) and did not waive either Federal or State ground water cleanup standards in the ROD. The United States conveyed this position to the Court. However, in a September 1989 decision by the United States District Court for the Northern District for New York, the Court found that, for the purpose of allowing the State to intervene in the Federal lawsuit, compliance with State ARARs had been waived. As such, with the knowledge of the Court and the parties, and in light of new, post-ROD scientific information suggesting that attainment of ground water standards may require more than 100 years regardless of the restoration method employed, EPA properly initiated an administrative process, consistent with CERCLA and the NCP, to reevaluate aquifer restoration alternatives (see, November 1990 Public Notice and Request for Comment on New Information Regarding Aquifer Restoration at the G.E./Moreau Superfund Site; see also, discussion herein on whether EPA's administrative action was taken in derogation of the Federal Court's jurisdiction). The commentator's reference that EPA's actions amount to a post-hoc rationalization is incorrect in that the Agency is, through a permissible and appropriate administrative proceeding, making a decision and articulating the basis for it. The doctrine of post-hoc rationalization involves an agency lawyer's actions in litigation after a decision is made, not the articulation of a decision made by an agency pursuant to an administrative process taken in accordance with appropriate statutes and regulations. EPA may always review and reconsider its remedial decisions if new information becomes available, as long as such review is not inconsistent with CERCLA and the NCP.

Comment: [Sullivan, transcript, p. 18] The Record of Decision has been tossed and the Consent Order withdrawn in Court.

EPA Response: The 1987 Record of Decision, as modified by the ESDs, is the document that specifies EPA's cleanup decision. The 1983 Consent Order between EPA and GE, which requires GE's performance of the remedy selected in the ROD, is in full force and effect. The Court vacated a Consent Decree signed by the U.S. Government and GE in settlement of the U.S. Government's claims against GE for failure to comply with the 1983 Consent Order (i.e., failure to install the extension of the alternative water supply system) when access was denied by the Town.

Comment 4 [Charlotte Lewis]: I would like a copy of the Judge's decision in this matter and the Judge's name, please.

EPA Response: The Honorable Con. G. Cholakis of the U.S. District Court for the Northern District of New York presides over the Federal litigation surrounding the Site (U.S. v. Town of Moreau, et al.; State of New York v. U.S. Environmental Protection Agency and the General Electric Company, C.A. No. 88-CV-934 (CGC)). In 1993, Judge Cholakis appointed The Honorable Daniel Scanlon, Jr. as Magistrate-Judge for this case. A copy of Judge Cholakis's October 12, 1990 decision has been sent directly to the commenter and is available from the U.S. District Court for the Northern District of New York, located in Albany, New York.

Comment: [Town, p. 38-40] EPA's waiver of ARARs is null and void because it is a unilateral administrative act that conflicts with, contradicts, and is in derogation of the Federal Court's continuing jurisdiction in this matter.

EPA Response: The Federal Court was well aware of the administrative process that EPA initiated and instead of seeking to enjoin it, the Court allowed EPA and the State to seek to resolve the State's claims raised in the Court action as part of that process. No motion was filed to enjoin EPA's actions and no order was ever entered by the Court precluding EPA from pursuing this administrative process.

Comment [Charlotte Lewis]: Who took the initiative to seek the waiver?

EPA Response: Following the September 15, 1989 court decision from the bench that ground water standards had been waived, in October 1989 EPA initiated reevaluation of selected remedy for aquifer restoration at the Site. In November 1990, EPA published notice announcing new information regarding aquifer restoration at the Site and the possible need to waive ARARs based on this new information (see, discussion above on Court's awareness of EPA's administrative actions). Following the November 1990

public notice, EPA invited the State, the Town, and GE to participate in technical discussions on this matter. EPA would like to clarify a statement made during the March 1, 1994 public meeting (see, March 1, 1994 Public Meeting Transcript, pp. 64-65): Robert Casson of C.A. Rich Consultants participated in these technical discussions on behalf of the Town, but did not request the waiver.

Protection of Human Health and the Environment and the Effect of ARAR Waiver Decision at Site

Comment 1: [Charlotte Lewis] Who benefits by this waiver? Will this waiver, in any way, benefit area wells, people's health, or the environment?

Comment 2: [Quinn] EPA has decided to let GE off the hook and not make them clean up the aquifer. GE should be made to clean up the aquifer no matter how long it takes or how much money it costs them.

Comment 3: [Jacox] It is we, the homeowners that will suffer grave consequences. I don't believe that you have considered our health and welfare in your proposal.

Comment 4: [GE] The remedy implemented at the Site remains protective of human health and the environment.

Comment 5: [Gutheil] Without the aquifer being restored or another water source provided to the undeveloped area overlying the ground water plume, the Town of Moreau will definitely have dead areas. I can tell you as a real estate broker that the Town and its residents have been damaged.

EPA Response: The goal of the Superfund program is protection of human health and the environment. Exposure to the contaminated ground water has been addressed by the provision of a permanent public water supply to residences affected or potentially affected by the Site and by treatment of the contaminated water at Reardon Brook. In a February 23, 1993 Site Review and Update prepared by the Agency for Toxic Substances and Disease Registry ("ATSDR"), ATSDR stated that it and the NYSDOH believe that no significant exposure to Site contaminants is currently occurring (see, Five-Year Report, p. 14-15, and discussion herein on alternative remedial strategies). The provision of public water supply to undeveloped areas is inconsistent with EPA guidance, which states, "[water demand] estimates [used to design the alternative water supply system] should not include projection for future growth because Superfund does not provide for the expansion of a community and will only correct problems within an existing system" (OSWER Directive 9355.3-03, Guidance Document for Providing Alternate Water Supplies, February 1988, p. 3-7). Nevertheless, EPA continues to recommend, as it did in the 1987

ROD, that the Town establish institutional controls for restricting the withdrawal of ground water within the plume area.

The TI waiver neither enhances nor diminishes the remedy selected by EPA in its 1987 ROD. Specifically, the waiver does not change the length of time it will actually take to restore the ground water at the Site. Rather, the waiver documents EPA's revision of the estimated time frame for aquifer restoration at the Site based on our current knowledge. The major components of the remedy continue to be the containment system, natural gradient flushing, air stripping at Reardon Brook, provision of an alternative water supply, maintenance and monitoring, and the five-year review. Moreover, the waiver does not change GE's ongoing obligation to implement and maintain the remedy as long as hazardous substances remain at the Site.

